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THE BATS OF WESTERN INDIA REVISITED¹

Part 1

P.J.J. BATES², D.L. HARRISON² AND M. MUNI³

(With a plate and four text-figures)

Key words: Mammalia Chiroptera, India, Gujarat, Maharashtra, Karnataka, distribution, ecology, systematics, status and conservation

The systematics, distribution, ecology and biology of seventeen species of Indian bats are reviewed in the light of field work conducted in Western India during March, 1992. Significant changes of status are noted in some species in comparison with previous surveys. Conservation priorities are highlighted.

INTRODUCTION

Thirty years ago Brosset published a series of papers on the ecology and distribution of the bats in central and western India. In these four studies, Brosset (1962a, 1962b, 1962c & 1963) gave detailed accounts of the habits and habitats of 35 species of bat at 43 localities. In doing so, he provided an invaluable bench mark against which future naturalists could com-

pare not only changes in species diversity at a particular site but also changes in population size.

The present authors revisited ten of the localities frequented by Brosset in an attempt to assess the fitness of the present bat populations vis-a-vis those observed thirty years previously. The localities were Bhuj, Rajkot and Ahmedabad in Gujarat; Mandu in Madhya Pradesh; Aurangabad, Ajanta; Ellora; Elephanta and Mahabaleshwar in Maharashtra; Belgaum and Talewadi in north-western Karnataka. All the localities were visited between 3 March and 28 March, 1992. This survey is part of a wider, longterm study to review the status, systematics, dis-

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²Harrison Zoological Museum, Bowerwood House, St. Botolph's Road, Sevenoaks, Kent, TN13 3AQ, England.

³Bombay Natural History Society, Hornbill House, Dr Salim Ali Chowk, Bombay 400 023, India.

tribution and ecology of all the Indian mammal species. A series of surveys to a range of contrasting biotopes within the Indian peninsula is being planned whilst a complementary study of the blood proteins is also being conducted by the junior author.

METHODS

Specimens of the cave dwelling species were generally collected during the day using hand held butterfly nets, with aluminium handles. Additionally, some cave entrances were netted during the evening using ten and thirty foot Japanese mist nets. This allowed for the collection of species whose diurnal roosts were located in inaccessible crevices. On three occasions mist nets were set up in the open in an attempt to collect free flying bats not traceable to any particular roost; the localities included a pool in an otherwise dry river bed at Ajanta; the edge of a medium-sized lake at Mandu and a cliff edge at Mandu. Although many bats were seen at each of these localities, the yields in the nets were low with one, nil and four specimens being caught respectively.

DEFINITIONS OF MEASUREMENTS

HB: head and body length — from the tip of the snout to the base of the tail; T: tail length — from the root of the tail to the tip; HF: hind foot — from the extremity of the heel to the tip of the longest digit, not including the claw; FA: forearm — from the extremity of the elbow to the extremity of the carpus with the wings folded; E: ear — from the lower border of the external auditory meatus to the tip of the pinna; GTL: greatest length of skull — the greatest antero-posterior diameter of the skull, taken from the most projecting point at each extremity; CBL: condylobasal length-

from an exoccipital condyle to the anterior extremity of the premaxillae; ZB: zygomatic breadth — greatest width of the skull across the zygomatic arches; BB: breadth of braincase — the width of the braincase at the posterior roots of the zygomatic arches; IC: interorbital constriction — the narrowest width across the interorbital region; PC: postorbital constriction — the narrowest width across the postorbital region; C-Mⁿ: maxillary tooththrow — from the front of the upper canine to the back of the crown of the last upper molar; C-M_n: mandibular tooththrow — from the front of the lower canine to the back of the crown of the last lower molar; M: mandible length — from the condyle of the mandible to its most anterior projecting point, including the lower incisors.

LIST OF SPECIES ENCOUNTERED

MEGACHIROPTERA

Rousettus leschenaultii
Pteropus giganteus
Cynopterus sphinx

MICROCHIROPTERA

Rhinopoma hardwickii
Taphozous longimanus
Taphozous melanopogon
Taphozous perforatus
Taphozous kachhensis
Megaderma lyra
Rhinolophus rouxii
Rhinolophus lepidus
Hipposideros fulvus
Hipposideros speoris
Hipposideros lankadiva
Otomops wroughtoni
Pipistrellus ceylonicus
Miniopterus schreibersii

Suborder MEGACHIROPTERA
Family PTEROPIDAE

Rousettus leschenaultii (Desmarest 1820) — Fulvous fruit bat

Pteropus leschenaultii Desmarest, 1820: Encyclopedique Method. Mamm., 1: 110. Pondicherry, India.

External characters: This is a medium-sized fruit bat with a short tail which protrudes from the interfemoral membrane. Males average larger than females with a mean forearm length of 83.2 mm (78-90 mm) as compared to females, 80.0 mm (74-84 mm). The ears are naked, conical in shape, partially opaque and a mid-brown colour throughout; there is no pale margin as in *Cynopterus*. The snout is well haired and robust, with the nostrils protuberant and separated from each other by a deep groove. The eyes, like those of all the Megachiroptera are relatively large; they appear dark brown by day and brilliant red in torch light. The pelage is a dull grey-brown throughout, tending to be paler on the shoulders in both sexes; occasionally greyer or more yellowish specimens are seen. Males have the glandular hairs on the throat more developed than the females, but not distinctively coloured. The wing membranes arise from the flanks and consequently the dorsal pelage is not narrowed. Both the first and second digits¹ of each wing are clawed.

Cranial and dental characters: The skull is robust, with the rostrum noticeably more elongated than that of *Cynopterus sphinx* and with the braincase larger. The dentition is relatively delicate with the cheekteeth narrow in relation to their length. The first upper premolar is greatly reduced, subequal in size with the first upper incisor.

Dental formula: $i\ 2/2\ c\ 1/1\ pm\ 3/3\ m\ 2/3 = 34$.

Measurements: Based on specimens of both sexes from throughout the Indian sub-continent.

	mean	range	s	n
HB:	124.6	102.0 – 148.0	10.9	45
T:	15.9	8.0 – 26.0	3.0	45
HF:	18.9	15.0 – 25.0	1.9	44
FA:	80.7	74.0 – 90.0	3.0	39
E:	20.8	18.0 – 23.0	1.5	43
GTL:	37.3	34.9 – 40.4	1.3	27
CBL:	35.7	33.5 – 38.8	1.3	26
ZB:	22.5	20.2 – 24.8	1.1	32
BB:	15.3	14.4 – 16.5	0.5	37
IC:	7.6	6.9 – 8.5	0.5	38
PC:	8.3	6.9 – 9.5	0.6	37
C-M ²	14.2	13.5 – 15.2	0.5	24
C-M ₃	15.8	14.8 – 17.2	0.6	25
M:	29.5	27.6 – 32.1	1.0	39

Ecology: *Rousettus leschenaultii* has a wide habitat tolerance, with an altitudinal range of 0-1000 metres (Bhat 1974) and an ability to survive in both arid and humid climates. Favoured roosts include caves, deserted buildings and tunnels. Unlike *Cynopterus* and *Pteropus*, it does not roost in trees. Colony size varies from 2 to several thousand individuals and the sexes are not segregated. It feeds primarily on fruits and flowers and additionally may take small fish (Ghose and Ghosal 1984). Some populations migrate seasonally in search of food.

Biology: According to Gopalakrishna and Choudhari (1977) who studied populations in Maharashtra, females may have two pregnancies in quick succession during the year. The first starts in the second week of November and terminates in the middle of March, although a few become pregnant



Fig. 1: *Roussettus leschenaultii* has a widespread distribution, extending from Sri Lanka, Pakistan, India and Nepal to Burma, Vietnam, southern China, Java and Bali.

Records from INDIA include Jhajjar Kotli [1], (Chakraborty, 1983) in **Kashmir & Jammu**; the districts of Kulu [2]; Kangra [3] and Mandi [4], (Bhat *et al.*, 1983) in **Himachal Pradesh**; Nasirabad [5], (Andersen, 1912); Jodhpur [6], (LACM coll.); Gagaron Ka Kila [7], (Sinha, 1980) in **Rajasthan**; Mehmabad [8]; Baroda [9], (Brosset, 1962a); Broach [10], (Sinha, 1981) in **Gujarat**; Chikalda [11]; Elephanta [12]; Jogeshwari [13]; Kanheri [14]; Khandala [15]; Alibag [16]; Mahabaleshwar [17]; Aurangabad [18]; Ratnagiri [19], (Brosset, 1962a); Marathwada [nl], (Gopalakrishna & Madhavan, 1970); Satara [20], (Sinha, 1980); Poona [21], (Rookmaaker & Bergmans, 1981); Ellora [22], (this paper); Mansar [59], (Bhide & Gupta, 1986); Kandri [60], (Karim & Gupta, 1986) in **Maharashtra**; Virajpet [22]; Nagarhole [23], (Ryley, 1913b); Krishnapur [24]; Belgaum [25]; Gersoppa [26]; Hampi [27], (Brosset, 1962a); Muroor [28], (Sreenivasan & Bhat, 1974) in **Karnataka**; Margao [29]; Poinguinam [30], (Agrawal, 1973); Vaddem Bardez [31], (BNHS coll.) in **Goa**; Trivandrum [32], (Sinha, 1980); Silent Valley [33], (Das, 1986) in **Kerala**; Zakampatti [nl], (Sinha, 1980); Madras [34], (Rookmaaker & Bergmans, 1981); Travancore [35], (BNHS coll.) in **Tamil Nadu**; Koduru [36], (BMNH coll.) in **Andhra Pradesh**; Khandagiri [37], (Sinha, 1980); Bhubaneswar [38]; Koira [39], (Rookmaaker & Bergmans, 1981) in **Orissa**; Lamataghat [40], (Khajuria, 1979); Mandu [41], (Brosset, 1962a) in **Madhya Pradesh**; Tanakpur [42], (Wroughton, 1914); Chunar [43], (HZM coll.) and the districts of Dehra Dun [46]; Pauri [45]; Almora [46]; Naini Tal [47]; Pithoragarh [48], (Bhat, 1974) in **Uttar Pradesh**; Chaibassa [49], (Sinha, 1980); the districts of Hazaribag [50]; Aurangabad [51] and Patna [52], (Sinha, 1986) in **Bihar**; Calcutta [53], (Rookmaaker & Bergmans, 1981); Pedong [54]; Hasimara [55], (BMNH coll.) in **West Bengal**; 17 km wsw of Mangan [56], (Ghose & Ghosal, 1984) in **Sikkim**; Siju Cave [56], (Sinha, 1980) in **Meghalaya**; Sei Josa [57], (Rookmaaker & Bergmans, 1981) in **Arunachal**; Kanchanpur [58], (Rookmaaker & Bergmans, 1981) in **Tripura**. Extralimital localities based on Roberts (1977) for **PAKISTAN**; Scully (1887) and BMNH coll. for **NEPAL**; Chakraborty (1975) for **BHUTAN**; Ryley (1914b), Wroughton (1915b) and Phillips (1924) for **SRI LANKA** and Wroughton (1915a), Carter (1943), Sinha (1980) and Das (1986) for northern **BURMA**.

NB: [nl] = not located.

MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of Colony	No. of specimens taken	Nature of biotope
Aurangabad (3 March)	Colony of about 100 individuals	2	In drainage tunnel beneath Bibi Ka Maqbara Mosque
Ellora (4 March)	Colony of about 150 individuals	0	In cave No. 29
Mandu (12 March)	Vast colony of several thousand individuals	2	In cellars of Champa Baoli
Mahabaleshwar (28 March)	Colony size not known probably considerable	2	In Robbers Cave a natural cave in a forested area.

in December and deliver their young in April or early May; the second starts soon after parturition and terminates at the end of July. Gestation lasts about 125 days and there is generally only one foetus. Females reach sexual maturity after five months and males after fifteen months. Infant mortality is high.

DISCUSSION

This species appears to be flourishing and has no doubt benefited from the increased agricultural activity of man. Brosset (1962a) reported that in February several colonies were found in the mosque and ruins of Mandu, with a total number of individuals estimated at between 1000 and 2000. Thirty years on and it appears to have consolidated its position into one huge colony of several thousand individuals in the extensive cellars of the Champa Baoli. In so doing, it has replaced a vast colony of *Hipposideros lankadiva* which Brosset (1962b) estimated to number between 5000 and 7000 individuals. At Aurangabad, a medium-sized colony of about 100 individuals

was located in the drainage tunnel beneath the Bibi Ka Maqbara Mosque. Brosset (1962a) had recorded a small colony of 8 to 10 individuals in the nearby Buddhist caves, but it was no longer present in this latter locality. The colony in cave No. 29 at Ellora was not noted by Brosset (1962a); the cave is relatively undisturbed and provides an ideal habitat for this species. The status of the colony at Robbers' Cave near Mahabaleshwar appears unchanged. However, it was not found at Elephanta. Possibly increased pressure from tourism has displaced it from these artificial caves.

Status: *Rousettus leschenaultii* has adapted well to man-made changes to the natural biotope. It requires no special protection or conservation measures. More detailed studies may suggest that it is gradually displacing the less adaptable Microchiropterans from a number of their traditional roosts and consequently some future control of its population size may prove to be desirable.

Pteropus giganteus (Brunnich, 1782) –
Indian flying fox

Vespertilio gigantea Brunnich, 1782:
Dyrenes Historie, 1: 45. Bengal, India.

External characters: This is the largest
Fruit bat known to occur on mainland India. It
is commonly seen hanging by its hind feet from
tall trees with its massive wings wrapped

developed paroccipital processes. The occipi-
tal region is subtubular, although the lambda
still forms the most posterior part of the
skull. The sagittal crest is present but weak.
The post orbital constriction is variable in
width, considerably narrower than the inter-
orbital width in some specimens and sube-
qual to it in others. The first upper premolar

MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of Colony	No. of specimens taken	Nature of biotope
Aurangabad (3 March)	Many individuals	0	Roosting in Banyan tree in city
Mandu (12 March)	Large colony, in excess of one hundred individuals	1	Roosting in mature trees near open water

NB. Colonies were seen in many other localities but no detailed notes were taken.

around its body. The wings arise from the
sides of the dorsum and consequently there
is a narrowing of the dorsal pelage. There is
no tail. The hind feet are large with strong
black claws. The ears are essentially naked,
dark brown or black in colour and conical in
shape. The muzzle is well haired and the
nostrils clearly defined. The pelage is a rich
chestnut brown on the crown of the head. On
the nape of neck, it varies from a light yel-
lowish tan to a deeper chestnut brown. It is
relatively darker around the eyes and mouth.
The pelage on the posterior shoulders and
dorsal region is short, sparse and black with
some paler hair tips. There is a clear line of
demarcation on the shoulders between the
chestnut hairs of the head and neck and the
dark hairs of the dorsum. The belly is most
variable in colour, apparently independent of
age, sex or season; it ranges from pale tan to
deep orange-red chestnut brown.

Cranial and dental characters: The
skull is massive with a long rostrum and well

is often deciduous. The first lower incisor is
usually distinctly smaller than the second.
Both m^2 and m_3 are greatly reduced.

Dental formula: $i\ 2/2\ c\ 1/1\ pm\ 3/3\ m\ 2/3$
 $= 34.$

Measurements: Based on specimens of
both sexes from throughout the Indian sub-
continent.

	mean	range	s	n
HB:	267.3	198.0 – 300.0	198.0	53
HF:	48.4	35.0 – 58.0	3.3	54
FA:	175.3	169.0 – 183.0	5.8	4
E	39.9	35.0 – 45.0	2.2	54
GTL:	72.1	66.8 – 77.3	2.2	44
CBL:	69.8	64.8 – 74.9	2.4	50
ZB:	39.2	34.0 – 44.0	2.4	50
BB:	24.7	23.4 – 25.8	0.6	51
IC:	10.0	8.9 – 11.6	0.6	57
C-M ² :	26.9	24.5 – 29.0	1.1	55
C-M ₃ :	29.6	26.8 – 33.0	1.8	52
M:	56.0	51.9 – 60.0	2.0	59

Ecology: *Pteropus giganteus* is a
colonial species that lives in large diurnal



Fig. 2: *Pteropus giganteus* has a widespread distribution extending from Pakistan, India and Sri Lanka through to Burma and south-west China.

Records from INDIA include Jhajjar Kotli [1], (Chakraborty, 1983) in **Jammu & Kashmir**; Kotla [2], (Breadon, 1932); Kulu [3], (Ferrari, 1934); Kangra [4], (Sinha, 1980); Simla [5], (BNHS coll.) in **Himachal Pradesh**; Gurdaspur District [6], (Breadon, 1932) in **Punjab**; Balsamand [7]; Dungarpur [8]; Banswara [9]; Parsad [10]; Mount Abu [11]; Berah [12]; Naga [13]; Nasirabad [14]; Jhalawar [15], (Sinha, 1980); Jaipur [16], (Prakash, 1961); Jodhpur [17]; Jhunjhunu [18]; Pali [19]; Sirohi [20], (Advani, 1982b) in **Rajasthan**; Bhuj [21]; Charwa [22], (Wroughton, 1912a); Junagadh [23]; Baradia [24]; Rajkot [25], (Ryley, 1913b); Deesa [26]; Danta [27], (Ryley, 1914a); Himatnagar [28]; Sultanabad [29]; Silvassa [30], (Sinha, 1981); Baroda [31]; Surat [32], (Advani, 1982a); Palanpur [33], (BNHS coll.) in **Gujarat**; Pili Sipna Valley [34]; Asirgarh [35]; Siwal [nl], (Wroughton, 1912a); Patan [36], (Wroughton, 1916a); Bombay [37]; Malad [38]; Thana [39], (McCann, 1934); Belapur [40]; Kalyan [41]; Ahmednagar District [42], (McCann, 1934); Amraoti [43]; Nagpur [44], (Moghe, 1951); Satara [45]; Poona [46], (Bastawde & Mahabai, 1976); Chanda [47], (Sinha, 1980) in **Maharashtra**; Avatgi [48]; Devikop [49]; Hawsbhavi [50]; Honkan [51], (Wroughton, 1912b); Vijayanagar [52], (Wroughton, 1913); Seringapatam [53], (Ryley, 1913a); Dharwar [54]; Kolar [55], (Sinha, 1980) in **Karnataka**; Molem [56], (Agrawal, 1973) in **Goa**; Trivandrum [57], (Sinha, 1980) in **Kerala**; Salem [58], (Sinha, 1980); Madras [59], (BMNH coll.); Keelarajakularaman [60]; Sri Vaikundam [61]; Ramanathapuram [62], (Marimuthu, 1988); Mudavaram [63]; Point Calimere [64], (BNHS coll.) in **Tamil Nadu**; Cuddapah [65], (Sinha, 1980); Balapalli Range [66]; Palkonda Hills [67], (BNHS coll.) in **Andhra Pradesh**; Narsinghpur [68], (Moghe, 1951); Chilka Lake [69], (Sinha, 1980) in **Orissa**; Guna [70]; Bhind [71]; Agar [72]; Gwalior [73]; Mukhi [74]; Supkhar [75], (LACM coll.); Balaghat [76], (Sinha, 1980); Sohagpur [77]; Narsingarh [78]; Ouda [79]; Sonawane [80], (Wroughton, 1913); Jabalpur [81], (Khajuria, 1979); Sehore [82], (BMNH coll.); Movar [83], (BNHS coll.) in **Madhya Pradesh**; Philibhit [84], (Wroughton, 1914); Kumaun [85]; Lucknow [86]; Varanasi [87], (Sinha, 1980); Mirzapur [88], (HZM coll.) in **Uttar Pradesh**; Chainpur [89]; Nimiaghat [90]; Luia [91], (Wroughton, 1915b); and the districts of West Champaran [92]; Siwan [93]; East Champaran [94]; Muzzaffarpur [95]; Sitamarhi [96]; Madhubani [97]; Darbhanga [98]; Samastipur [99]; Begusarai [100]; Saharsa [101]; Purnea [102]; Katihar [103]; Palamau [104]; Patna [105]; Hazaribagh [106]; Ranchi [107]; Singhbhum [108]; Giridih [109]; Bhagalpur [110]; Santal Pargana [111], (Sinha, 1986); Bongoan [nl]; Amarpura [112], (Sinha, 1980) in **Bihar**; Calcutta [113], (LACM coll.); Salbani [114], (Wroughton, 1915b); Burdwan [115]; Duars [nl]; Siliguri [116], (Sinha, 1980); Hasimara [117]; Jalpaiguri [118], (BMNH coll.) in **West Bengal**; Gangtok [119], (Ghosal & Ghose, 1984) in **Sikkim**; Cachar [120], (Andersen, 1912); Doom [121]; Golaghat [122], (BNHS coll.); Sadiya [130], (Kurup, 1968) in **Assam**; Shillong [123], (BMNH coll.) in **Meghalaya**; Kochim-kooleh [124], (Andersen, 1912) in **Manipur**; Amarpur [125], (Agrawal & Bhattacharyya, 1977) in **Tripura**. Localities in the **Maldives** include Hululay Island [126]; Gan [127]; Addu Atoll [128] and Male Atoll [129], (BMNH coll.). Extralimital localities are based on Roberts (1977) for **PAKISTAN**; Scully (1887) for **NEPAL**; Siddiqi (1961) for **BANGLADESH**; Wroughton (1915b) and Phillips (1924) for **SRI LANKA** and Sinha (1980) for northern **BURMA**.

roosts which may comprise hundreds or even thousands of individuals. Colonies are usually located in close association with man and tend to be found in well established trees in cities and villages. The diet is primarily comprised of fruits. In the non-fruiting season, individuals are known to chew soft leaves and twigs and eat flowers (Sinha 1986). Within a colony, each male has a rank and a particular resting place; young males live separately from March to October. Colonies may break up into smaller feeding groups at sunset and immense distances, sometimes in excess of 20 km, may be covered in search of food. During the summer, individuals flap their wings and salivate on their bodies in an attempt to reduce body temperature (Neuweiler 1969). Local, seasonal migration may also occur, as individuals seek cooler localities in summer or more productive areas (Bastawde and Mahabal 1976).

Biology: In Madras, the mating season is from July to the beginning of October; copulation occurs three times in sequence and individuals may trigger a mass copulation within a colony. Females collect in the upper branches to give birth and the young are born in March in Tamil Nadu. For the first few weeks they are carried by their mothers but from May onwards they are left alone in the roost (Neuweiler 1969). Females in Bihar in April were mostly pregnant, each having a single foetus (Sinha 1986).

DISCUSSION

Since neither this paper nor that of Brosset (1962a) made a detailed study of this taxon, it is not possible to assess the change of status of this species over the past 30 years.

Status: Empirical evidence suggests that

this continues to be a common species in no need of special conservation measures.

Cynopterus sphinx (Vahl, 1797)—
Short-nosed Fruit bat

Vespertilio sphinx Vahl, 1797 — Skrifter Nat-Selsk. Kiobenhaven, 4(1): 123. Tranquebar, Madras, India.

External characters: This is a medium-sized Fruit Bat with a very short tail. The pelage of males is a rich orange brown on the chin, anterior part of the shoulders, and the sides of the chest, belly and thighs. In females, the collar tends to be a more tawny brown. The forehead and nape of the neck are a rich russet brown. The posterior back is grey brown; the belly is a paler grey. The males have neck tufts comprised of a semi-rigid ruff of hairs. The ears are essentially naked, mocha brown in colour but with characteristically well defined pale anterior and posterior borders. The wing and interfemoral membranes are dark brown but with the fingers noticeably pale.

Cranial and dental characters: The rostrum is short and broad and the zygomata are relatively heavy in comparison to those of *Rousettus leschenaultii*. The postorbital constriction is well developed and the braincase is relatively small. The dentition is reduced with both m^2 and m_3 absent. The second upper premolar is equal in crown area to the third and is relatively much larger than that of *Rousettus*. The mandibular cheekteeth are relatively heavy in comparison to those of *R. leschenaultii*.

Dental formula: $i\ 2/2\ c\ 1/1\ pm\ 3/3\ m\ 1/2 = 30$.

Measurements: Based on specimens of both sexes from throughout the Indian subcontinent.



1. *Roussettus leschenaultii*; 2. *Pieropus giganteus*; 3. *Cynopterus sphinx*; 4. *Rhinolophus hardwickii*.

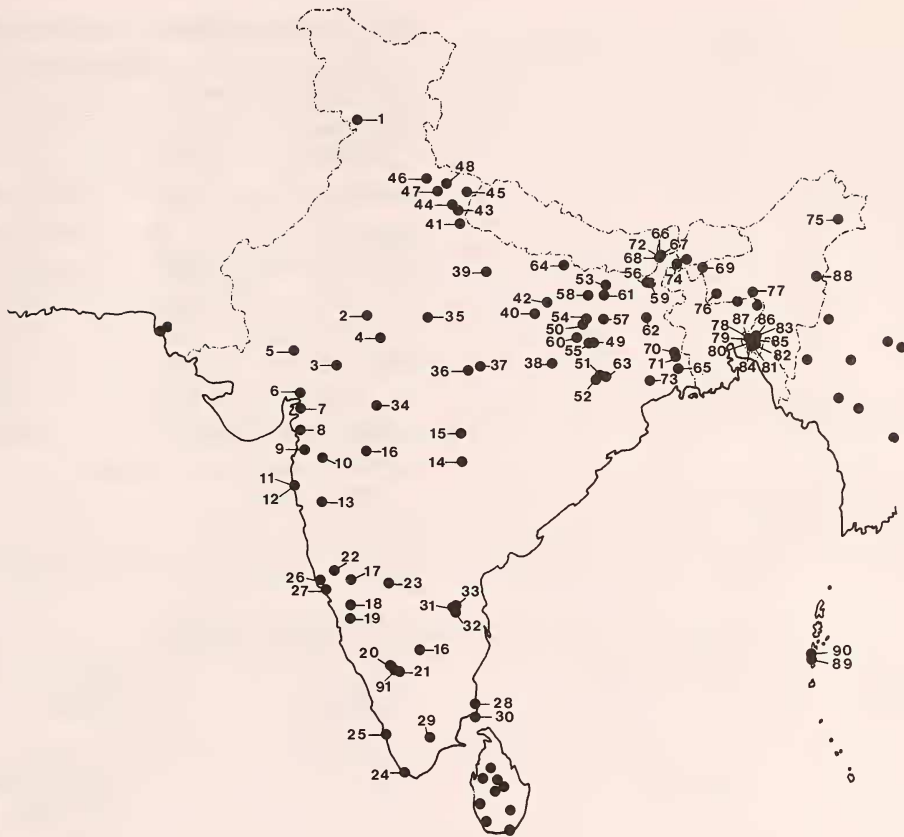


Fig. 3: *Cynopterus sphinx* is widely distributed with a range that extends from India and Sri Lanka to southern China, Malaya, Java, Lesser Sunda Island, Borneo and Sulawesi.

Records from INDIA include Jhajar Kotli [1], (Chakraborty, 1983) in **Jammu & Kashmir**; Bundi [2]; Banswara [3]; Jhalawar District [4], (Advani, 1982) in **Rajasthan**; Danta [5], (Ryley, 1914a); Anand [6]; Vedral [7], (Brosset, 1962a); Surat [8]; Silvassa [9], (Sinha, 1981) in **Gujarat**; Nasik [10]; Bandra [11]; Bombay [12], (Andersen, 1912); Poona [13]; Chanda [14], (Brosset, 1962a); Nagpur [15], (Das & Sinha, 1971); Ajanta [16], (this paper) in **Maharashtra**; Bangalore [16]; Mysore [91], (Das & Sinha, 1971); Dharwar [17], (Andersen, 1912); Sirsi [18]; Honawar [19], (Wroughton, 1913); Seringapatam [20], (Ryley, 1913a); Virajpet [21], (Ryley, 1913b); Belgaum [22]; Hampi [23], (Brosset, 1962a) in **Karnataka**; Trivandrum [24], (Andersen, 1912); Cochin [25] in **Kerala**; Margao [26]; Valpoi [27], (Agrawal, 1973) in **Goa**; Tranquebar [28], (type locality of *sphinx*); Madurai [29], (Sinha, 1980); Point Calimere Sanctuary [30], (Balasubramanian, 1988) in **Tamil Nadu**; south Cuddapah [31], (Phillips, 1924); Koduru [32]; Balapalli [33], (BNMH coll.) in **Andhra Pradesh**; Nimar [34], (Wroughton, 1912b); Orcha [35], (Brosset, 1962a); Jabalpur [36]; Shahpura [37], (Khajuria, 1979); Ambikapur [38], (Khajuria, 1984) in **Madhya Pradesh**; Lucknow [39] (type locality of *gangeticus*); Mirzapur [40], (HZM coll.); Philibhit [41], (BMNH coll.); Banaras [42], (Khajuria, 1953); and the districts of Naini Tal [43]; Almora [44]; Pithoragarh [45]; Dehra Dun [46]; Pauri [47] and Chamoli [48], (Bhat, 1974) in **Uttar Pradesh**; Barkagaon [49]; Singar [50]; Luaia [51]; Koira [52], (Wroughton, 1915b) and the districts of Darbhanga [53]; Gaya [54]; Hazaribag [55]; Katihar [56]; Munger [57]; Patna [58]; Purnea [59]; Rohtas [60]; Samastipur [61]; Santal Pargana [62]; Singhbhum [63] and West Champaran [64], (Sinha, 1986) in **Bihar**; Calcutta [65], (Andersen, 1912); Singla [66], (Wroughton, 1916b); Tong Song [67], (Wroughton, 1916c); (specimens from Pashok listed in Wroughton, 1916c were subsequently referred to *Megaerops*, Hill, 1983); Gopalahara [68]; Bharna Ghari [nl]; Hasimara [69], (BMNH coll.); Madanpur [70]; Parmadan [71], (Das & Sinha, 1971); Darjeeling [72]; Duars [nl], (Sinha, 1980); Salbani [73], (Wroughton 1915b); Jalpaiguri [74], (Bhat, 1974) in **West Bengal**; Namdapha [75], (specimens referred to *C. angulatus* in Saha, 1985) in **Arunachal Pradesh**; Garo Hills [76], (Kemp, 1924); Cheerapunji [77], (Sinha, 1980) in **Meghalaya**; Agartala [78]; Charilam [79]; Garjee [80]; Abhoya [81]; Teliamura [82]; Ampri [83]; Ambassa [84]; Ganganagar [85]; Chailingta [86]; Kanchanpur [87], (Agrawal & Bhattacharyya, 1977) in **Tripura**; Naga Hills [88], (Sinha, 1980) in **Nagaland**. It is also known from Port Blair [89], (Chaturvedi, 1959) and Mandapahar [90], (J.E. Hill pers. comm.) in the **Andaman Islands**. Extralimital localities are based on Roberts (1977) for **PAKISTAN**; BMNH coll. and Ellerman & Morrison-Scott (1951) for **BANGLADESH**; Ryley (1914a), Wroughton (1915b) and Phillips (1924) for **SRI LANKA**; Saha (1980) for **BHUTAN**; Ryley (1914a) and Wroughton (1915a, 1916a, 1916c) for northern **BURMA**.

	mean	range	s	n
HB:	98.1	82.0 – 114.0	8.9	53
T:	12.3	5.0 – 18.0	3.5	52
HF:	15.6	10.0 – 18.0	1.3	53
FA:	74.0	69.0 – 82.0	2.7	9
E:	20.8	18.0 – 24.0	1.5	49
GTL:	32.4	29.8 – 34.9	1.3	48
CBL:	30.9	28.5 – 33.0	1.4	42
ZB:	20.7	18.3 – 23.1	1.1	46
BB:	13.4	11.1 – 14.8	0.6	56
IC:	6.4	5.4 – 7.7	0.5	59
C-M ¹ :	11.0	9.2 – 12.2	0.6	57
C-M ₂ :	12.2	9.7 – 13.5	0.9	61
M:	24.9	22.6 – 27.5	1.2	62

Ecology: *Cynopterus sphinx* is a common Fruit bat generally found in small, single sex colonies of three to four individuals

1989). When feeding, it seldom clings to branches but tends to maintain itself in the air with swift wing beats, biting at the fruits in flight and devouring them on the wing.

Biology: In Maharashtra, there are two periods of sexual activity, one during September-October, the other during February-March. Gestation lasts for between 115 and 125 days and individuals are born in February-March and June-July (Sandhu 1988). There is usually only one foetus and full adult size is achieved in two months (Krishna and Dominic 1983). Females may be both lactating and pregnant.

Discussion: It is not possible to determine if there have been any significant changes in the population size of

MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992:

Locality (Date)	Size of Colony	No. of specimens taken	Nature of biotope
Ajanta (5 March)	Not known	1	Caught in mist net in river valley

(Khajuria 1979). In the breeding season groups of 5-10 males and 10-15 females are formed (Krishna and Dominic 1985). It most often roosts on the underside of the leaves of palms or concealed in the crevices of banyan, peepul, palm or coconut trees (Chakraborty 1983); it may also frequent deserted buildings (Brosset 1962a). It is found in heavy forest, cultivated areas and even in big cities such as Bombay. Its flight is low and comparatively fast and it uses its acute sense of smell to detect its food. It feeds on the fruits of some 25 plant species, including guava, ber, mango, date palm, custard apple, lychee and banana; it is also known to eat leaves and to collect nectar from flowers (Balasubramanian

this species during the last 30 years. The secretive nature of the roosts make a direct comparison with the findings of Brosset (1962a) impossible.

Status: Anecdotal evidence suggests that this is a common species, even within the confines of urban Bombay. Further studies to substantiate these suggestions would be of value.

Suborder MICROCHIROPTERA

Family RHINOPOMATIDAE

Rhinopoma hardwickii Gray 1831 - Lesser Mouse-tailed bat

Rhinopoma hardwickii Gray, 1831: Zoological Miscellany, 1: 37. India.

External characters: This is a medium-sized Microchiropteran with a characteristically long, slender tail, the greater part of which extends free from the membrane. The tail, on average, is equal to the length of the head and body and usually exceeds

is also more developed than that of *R. microphyllum*. The sagittal crest, although present is less prominent than that of the larger species. The dentition is unremarkable; it is smaller than that of *R. microphyllum*, the upper toothrow of which averages 7.5 mm

MATERIAL SEEN AND/OR COLLECTED IN MARCH 1992

Locality (Date)	Size of Colony	No. of specimens taken	Nature of biotope
Rajkot (March 18)	Small colony-exact number not known	1	Secreted in cracks in low ceiling of building adjacent to Kirisara Fort

forearm length. In *Rhinopoma microphyllum*, also found in India, tail length (mean= 58.8 mm; 50-78 mm) is usually less than both forearm length (67.9 mm; 58-74 mm) and head and body length (75.3 mm; 65- 84 mm). The face, ears and connecting membrane between the ears on the forehead are all naked and fleshy brown in colour. A small, but well defined triangular dermal ridge is present on the snout and there is a well developed pit at the base of the muzzle between the large eyes. The pelage is a uniform light grey brown on the back and is slightly paler on the belly. The lower back and belly are naked. The flight is relatively high but also weak and slow and is accompanied with a peculiar fluttering of the wings (Wroughton 1913).

Cranial and dental characters: The skull is characterised by the large nasal inflations present on either side of the rostrum. These inflations are more developed than those of *R. microphyllum*, the skull of which is significantly larger with a mean greatest length of 20.9 mm (19.2-22.3 mm). The median hollow between the nasal inflations

(6.8-8.0 mm) in length.

Dental formula: $i \frac{1}{2} c \frac{1}{1} pm \frac{1}{1} m \frac{3}{3} = 28$.

Measurements: Based on specimens of both sexes from throughout the Indian sub-continent.

	mean	range	s	n
HB:	66.7	55.0 – 74.0	4.2	40
T:	66.7	56.0 – 77.0	5.5	40
HF:	13.4	11.0 – 15.0	1.2	34
FA:	60.0	54.0 – 64.0	2.2	29
E:	19.2	16.0 – 21.0	1.0	40
GTL:	18.7	17.5 – 19.7	0.5	31
CBL:	17.1	16.1 – 18.1	0.5	29
ZB:	10.9	10.2 – 11.6	0.4	34
BB:	8.2	7.8 – 8.6	0.2	43
PC:	2.8	2.6 – 3.2	0.2	45
C-M ³ :	6.4	6.0 – 6.8	0.2	46
C-M ₃ :	7.0	6.5 – 7.5	0.3	43
M:	12.8	11.8 – 13.6	0.4	45

Ecology: *Rhinopoma hardwickii* favours dry and semi-desert areas, sub-tropical dry evergreen forests and tropical thorn forests (Siddiqi 1961). It is a sociable species usually found in small colonies of between four and



Fig. 4: *Rhinopoma hardwickii* has a widespread distribution ranging from Niger, Morocco and Mauritania to East Africa, Arabia, Iran, Afghanistan, Pakistan, India, and possibly Burma and southern Thailand, (Hill, 1977).

Records from INDIA include Nasirabad [1], (BMNH coll.); Jaipur [2], (BNHS coll.); districts of Jodhpur [3]; Nagaur [4]; Jhunjhunu [5]; Ajmer [6]; Dungarpur [7]; Jhalawar [8] and Bundi [9], (Sinha, 1980) in Rajasthan; Junagadh [10]; Rajkot [11]; Vankaneer [12], (Ryley, 1913b); Palanpur [13]; Lunwa [nl]; Danta [14], (Ryley, 1914a); Bhuj [15]; Anand [16]; Ahmedabad [17]; Vedtia [18], (Brosset, 1962a) in Gujarat; Bellary [19], (Wroughton, 1913); Pattadkal [20]; Badami [21]; Vijayanagar [22], (Brosset, 1962a); Gokarna [23], (Bhat & Sreenivasan, 1972); Gadag [24], (BMNH coll.) in Karnataka; Dharmapuri Range [25]; Travancore [26], (BNHS coll.); Madurai [27], (Kock & Felten, 1980); Kanavi Katha Bootham [nl], (Usman, 1988); Palni Hills [28], (BMNH coll.) in Tamil Nadu; Palkonda Hills [29], (BNHS coll.); Koduru [30], (BMNH coll.) in Andhra Pradesh; Narsingarh [31], (Wroughton, 1913); Orcha [32]; Gwalior [33]; Sanchi [34]; Asirgarh [35]; Khajurao [36]; Mandu [37], (Brosset, 1962a); Jabalpur District [38], (Khajuria, 1979); Ghatigaon [39], (BMNH coll.) in Madhya Pradesh; New Delhi [40], (Brosset, 1962a) in Delhi; Fatehpur Sikri [41]; Agra [42], (Brosset, 1962a); Allahabad [43], (BMNH coll.) in Uttar Pradesh; Singar [44], (Wroughton, 1915b); Gaya [45]; Bhojpur [46]; Giridih [47]; Munger [48]; Rohtas districts [49], (Sinha, 1986) in Bihar; Calcutta [50], (BMNH coll.) in West Bengal. Extralimital localities are based on BNHS coll., Siddiqi (1961) and Roberts (1977) for PAKISTAN.

100 individuals although Sinha (1986) reported 500 from a locality in Bihar and Usman (1988) 1500 from a single cavern in Madurai district. Colonies are thought to be sexually segregated (Brosset 1962a). Roosting sites include caves, houses, ruins and cracks amongst boulders. The bats impregnate the area with their characteristic smell. The diet includes moths, insects and beetles. Although this species does not hibernate, it does have periods of extended rest during which it lives off copious fat reserves. The reserves, that may double an individual's body weight, are formed in the post monsoon period (October) in north-west India when insects are plentiful. They are progressively utilised during the winter and spring and disappear during May-June. There is some temporal variation in the cycle of fattening between the different geographical areas of India (Brosset 1962a)

Biology: In Uttar Pradesh, copulation occurs during the last week of February and the first week of March; ovulation commences after 11 March and gestation lasts 95 to 100 days. Births of the single infants occur either in late June or early July; lactation lasts about two months and females reach sexual maturity at about 9 months (Banerjee and Karim 1982).

Discussion: During the March 1992 survey, *Rhinopoma hardwickii* was encountered once at Kirisara Fort near Rajkot. Brosset (1962a) located this species at sixteen sites. His records included four individuals in the Hindola Mahal ruins of Mandu in February; 70-80 individuals in the Dada Hari Well in Ahmedabad in November and 25-30 individuals at the same locality in June; 10-15 individuals were observed by him on the ceiling of a mosque in Ahmedabad in November. Previously, seven individuals were collected from the old fort of Junagadh in October 1912 (Ryley 1913b). All these localities were re-surveyed during the present study, but no trace of *Rhinopoma* was found.

Status: Although this is presumed to be a common species in India, our brief survey found it to be rare. As noted above, former colonies appear to have been deserted. One possible explanation is that *R. hardwickii* is a seasonal migrant and was temporarily absent from the sites previously surveyed by Brosset (1962a) and Ryley (1913b). However, there is also the possibility that there has been a significant fall in its population size. Further studies of Brosset's localities during the months of his original survey would help to determine the present status of this species.

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(to be continued)